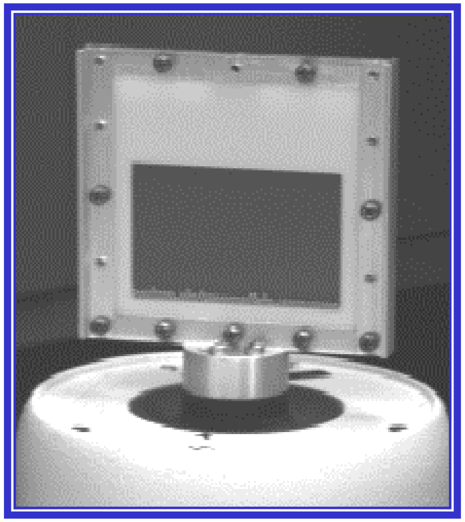
CAREER: Experimental studies of fluidized granular media
Narayanan Menon, University of Massachusetts, DMR-0987433

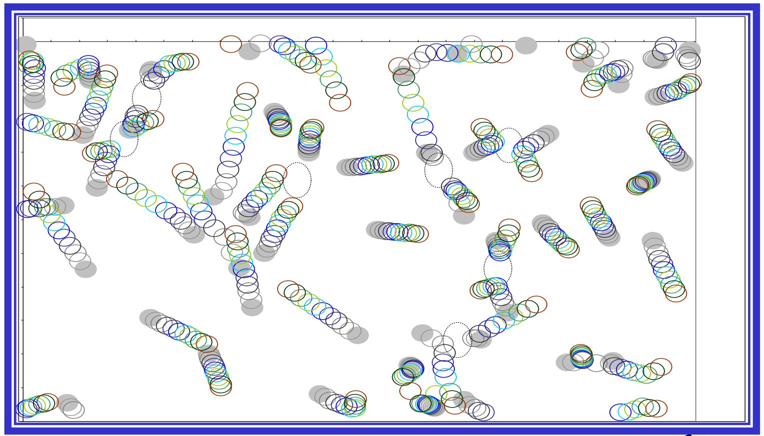
Granular fluids such as flowing sand are made up of macroscopic grains that interact by dissipative interactions such as friction and inelastic collisions. The dynamics in a such a fluid are driven by external forces rather than thermal energy. However, there have been several theroretical efforts to try and describe such systems using ideas from statistical physics.

A starting points in such a description is the idea of a granular temperature, which by analogy to the thermodynamic temperature is defined as the mean kinetic energy of particles. To test this analogy we have previously studied the kinematics of a set of steel beads in a vigorously excited 2-dimensional cage and found that the granular temperature does display certain attributes of a temperature variable.

In our most recent experiments, we ask whether the granular temperature has a zeroth law. We find that mixtures of grains violate equipartition of energy, but in an extremely systematic way, with the extent of violation being dependent only on single particle properties and independent of compositional parameters. Apart from the scientific interest of the findings, the practical implications are important, since multicomponent, polydisperse mixtures are ubiquitous in most industrial settings



2D cage mounted on a vibration stage (above); particle tracks from 10 consecutive frames (below)



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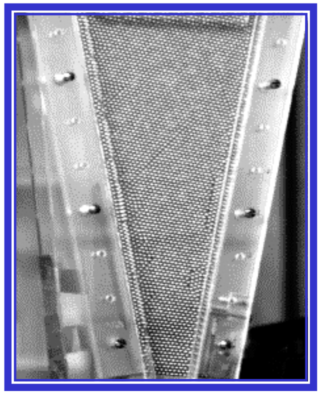
Educational:
4 undergrads,
2 grad students.

In the last three years, 21 undergraduates students have worked in the lab, greater than half that number on granular media. All undergraduate students are given independent responsibilities i.e. an experiment of their own. This has led to 4 senior theses in this area and published work by undergraduate students.

Presented three tours entitled “Physics in the Sandbox” for Massachusetts high-school science students.

We have an ongoing collaboration with Prof. N Easwar from the Physics Department at Smith College; she has brought five Smith undergrads to work in my lab at UMass over the last three years.
We have studied pressure fluctuations at the walls of dense granular flows such as the funnel flow shown below. We find that the force



distribution at the boundary of such a flow is a broad, exponential distribution that was previously only known to occur in static granular assemblies.